[With the Author's Compliments.

The Aseptic Treatment of Wounds in Ophthalmic Surgery.

BY

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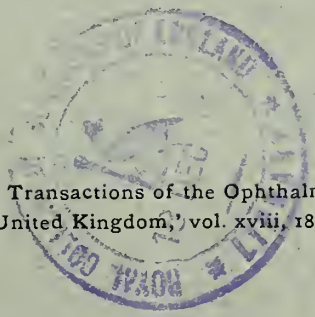

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The aseptic treatment of wounds in ophthalmic surgery.

By Angus McGillivray, M.D.

It is impossible to shut our eyes to the fact that the treatment of wounds has undergone a very rapid process of evolution since the introduction of antiseptic principles into surgery by Lister. This is not to be wondered at when we consider the intimate relation that exists between the rapidly advancing science of bacteriology and modern surgical technique. By the application of antiseptics in the treatment of wounds, Lister proved beyond all doubt that the secret of success in operative surgery lies principally in the exclusion of micro-organisms from wounds, both during and after operation. With the advent of such an important discovery, it is not to be wondered at that surgeons were carried away with the idea that the destruction of the invading micro-organisms must be carried out at all costs, the protection of the cut tissue of the wound against the chemical agents employed being lost sight of, or at all events thought to be of secondary importance. We must, however, remember that the science of bacteriology was practically in its infancy at the commencement of the antiseptic era, for Lister's discovery, besides being of incalculable value to surgery, gave a great impetus to the study of bacteriology, which study has culminated in the production of acquired immunity against some of our most virulent maladies.

As the life history of micro-organisms became better understood, antisepticians found that certain precautions, which they had adopted at the outset, were not only un-

necessary, but were even harmful, and this resulted in certain important modifications in the original methods. These modifications consisted chiefly in reducing, by a very appreciable extent, the strength of the antiseptics employed, especially those that came in contact with the wound, and the abandonment of the carbolic spray. The dangers of aërial infection, which haunted the surgeon like a nightmare, were removed by the simple discovery that micro-organisms, like dust particles, were subject to the law of gravitation. This led to the adoption of special precautions, which have been successful in removing this formidable difficulty, or at least making it no longer a practical objection. Next came the disinfection of instruments, mops, dressings, and ligatures by heat sterilisation, as immersion in chemical "antiseptics" could not be relied upon. Thus the use of chemical disinfectants became restricted, in the practice of most surgeons, to the disinfection of the surgeon's hands, and the skin over the part to be operated on.

The important researches of Lister, Tyndall, Pasteur, and others, proving that unexposed healthy tissues are free from micro-organisms, and that suppuration is due to the introduction of micro-organisms from without, paved the way for still further modifying, or simplifying, antiseptic methods. It was not, however, until the importance of the natural antiseptic property, or natural immunity of living tissues came to be more appreciated, that some surgeons discarded chemical antiseptics in operations altogether, and preferred normal saline solution, as that produced no irritation of the wounded tissues, tending rather to keep them as nearly as possible in their physiological condition.

It is well known that antiseptic solutions, however weak, irritate or benumb the cut tissues of a wound, and that this irritation is, as a rule, in proportion to the strength of the solution employed. In some cases the antiseptic actually destroys the tissues on the surface of the wound altogether, so that, before union takes place,

the dead part thus lying between the lips of the wound must be got rid of. Now if the tissues are irritated or benumbed by chemical antiseptics, they are less able to ward off any micro-organisms that may have found their way into, and are left in the wound. In other words, the natural immunity or antiseptic property of the tissues becomes impaired or destroyed.

Again, it has been shown experimentally that the removal of micro-organisms from wounds by douching with antiseptic solutions depends chiefly, or probably entirely, on the mechanical irrigation, and not, as was formerly supposed, on the germicidal action of the antiseptic. The antiseptic solutions employed in surgery for douching purposes have no practical germicidal properties unless they are brought into direct contact with the organisms for several hours, or even days. This, however, would be a very undesirable procedure, even if possible, as prolonged action of the antiseptic is disastrous to the tissues. The resisting power of the organisms against antiseptics is considerably greater than that of the living tissues, so that any attempt to destroy organisms in a wound by chemical antiseptics will play havoc with the tissues long before the organisms become affected. The addition, therefore, of an antiseptic to a solution for douching purposes is not only superfluous, but actually injurious to the tissues.

The result of these discoveries has been a considerable modification in the practice of antisepticians, a modification which is also a simplification, and which, carried further, has led to the adoption of asepsis as a natural development.

In practice, most surgeons, antisepticians and aseptic ians alike, sterilise their instruments by heat, they employ methods similar in principle for the disinfection of their hands and the skin of the patients, and take the same or similar precautions in preparing their operating theatres and the patients' surroundings. They differ, however, in the following :—The antiseptician employs

antiseptic solutions for his wounds, for immersing his instruments in after sterilisation, and uses, as dressings, absorbent materials impregnated with chemical antiseptics. The aseptician, on the other hand, carefully removes the chemical disinfectants both from his own hands and from the skin over the part to be operated on, the instruments are not kept in antiseptic solutions after sterilisation, the wound is douched only with sterilised saline solution, antiseptics are studiously prevented from coming in contact with the wound, and the dressings are composed of sterilised absorbent materials. His object in such precautions is to disturb the tissues of the wound as little as possible, and he trusts to the natural antiseptic or germicidal action of the tissues in combating or destroying any micro-organisms that may have been left in the wound, rather than trust to artificial means, which impair the natural immunity of the tissues. The aseptician adopts the same or analogous precautions during his operations, as regards the exclusion of micro-organisms and antiseptics, as a bacteriologist adopts in the preparation and subsequent inoculation of his culture media,—that is, he brings the rules and methods employed in the bacteriological laboratory into the operating theatre with him. In short, aseptic surgery may be defined as *applied bacteriological methods in surgical technique.*

Having thus stated the position of the aseptician generally, let me illustrate more fully by describing and analysing a typical operation, such as cataract extraction, performed on aseptic principles.

Cataract extraction.—On admission into hospital the patient gets a warm bath and a change of underclothing, and is then put to bed. The face is carefully washed with warm water and soap, particular attention being paid to the folds in the skin of the eyelids. In the evening the eyes are bathed with sterilised salt solution ·6 per cent., and a *test dressing* is applied over the eye to be operated on. Should this dressing be found unstained when removed next morning the eye is considered suitable for

operation. We, however, prefer the patient to be in hospital for at least a couple of days before being operated on, so that he may become accustomed to his new surroundings. On the morning of the operation, and about an hour and a half before the surgeon's arrival, the eyelashes are cut short, and the face and eye are treated as on the day of admission. Sterilised cocaine drops 5 per cent. are instilled into the eye for twenty minutes before operating to ensure complete anæsthesia of the deeper parts, corneal desiccation being prevented by keeping the eyelids closed. The surgeon wears a white operating jacket, closely fitting at the neck, with sleeves rolled halfway up the forearm. His hands are very carefully washed in water, and disinfected with a carbol-sublimate solution, which is removed before operating by washing the hands in sterilised water. The margins of the eyelids, especially the openings of the Meibomian ducts, are gently rubbed with a sterilised mop and saline solution. This mechanical cleansing can be carried out without irritating the eye if the margins of the eyelids, after being approximated, be pressed together until they become slightly everted. After this the patient is directed to keep opening and closing his eyelids while a stream of saline solution at the temperature of about 90° F. is made to play over the eyeball. The upper lid is then everted, and the conjunctival surface of the tarsus carefully cleansed by pouring the solution from a little height. The cleansing of this part of the conjunctiva is very important, seeing that the tarsus is to lie in actual contact with the wound, and in reality form the innermost and therefore the most important part of the dressing. The lower cul-de-sac is in turn exposed and douched, and the lachrymal sac emptied by making firm pressure over it with the finger. Flushing the lachrymal sac and tear duct on the evening before operation was practised by us for some time, but was abandoned about eighteen months ago, because it produced more or less redness and irritation of the conjunctiva at the inner canthus. The upper cul-de-sac receives attention next.

Special douches have been devised for the purpose of irrigating the upper cul-de-sac, but they are all open to the objection that the nozzle is apt to irritate the conjunctiva if employed with any degree of thoroughness. We now content ourselves with the following simple means of dealing with the upper cul-de-sac :—Place the patient's chin on a level slightly higher than the forehead, and lift the upper eyelid forward off the eyeball ; the saline solution from the douche is thus allowed to pass down into the cul-de-sac and cleanse the part freely without causing irritation or discomfort. [It may be of interest to mention in passing, that normal saline solution when dropped into the eye has a soothing effect, whereas ordinary tap water temporarily irritates the eye to some extent.]

The instruments are sterilised by being kept submerged in boiling water for two and a half minutes. They are then laid out in the order in which they are to be used on a sterilised cloth, and covered up till required.

Operation.—The speculum is now inserted, and the fixation forceps applied just below the cornea. The eyeball is rotated downwards, and the exposed upper corneo-scleral region corresponding to the wound douched with a stream of saline solution. A corneo-scleral incision, with 3 mm. flap and a narrow conjunctival flap, is made with a sharp Graefe's knife. After completing the section the fixation forceps is removed, but the patient is enjoined not to rotate the eye upwards until the operation is completed. This avoids the possibility of the wound being contaminated by the margin of the upper eyelid. A narrow iridectomy and a free capsulotomy are performed, and the lens is expelled by spoon and curette, without any difficulty as a rule. After removing any soft lens matter, and replacing the pillars of the iris coloboma, the lips of the wound are freed of any débris by a gentle stream of saline solution. The conjunctival flap is carefully replaced on the sclerotic, and the speculum removed. In removing the speculum care should be taken that the upper lid is carefully lifted over the

wound, and not allowed to glide over it, for fear of eontaminating or displacing the lips of the wound.

Dressing.—Over the eye is laid an oval piece of moist lint or gauze $1\frac{1}{2} \times 1$ inches, which has simply been sterilised, then two layers of absorbent eotton wool, just large enough to overlap the lint. This dressing is retained in position by a vertical and horizontal strip of half-inch adhesive rubber plaster. It is called a *single plaster dressing.*

The patient is then wheeled on the operating table into the ward, and placed carefully in bed. A large double shade of brown paper is worn over both eyes from the time of the operation till leaving the hospital.

At the first dressing, forty-eight hours after operation, the lint next the eye is, as a rule, unstained; there is seldom any trace of gumminess of the lids, even in very old and deerepit people, and only a trace of conjunctival injeetion over the globe. During this and subsequent daily dressings the eye is bathed with saline solution, and sterilised atropine drops are instilled to dilate the pupil and keep the iris at rest. The patient is allowed to sit up in bed with back support on the third day, or sooner if the supine position be eontra-indicated. He is allowed to move about in the ward, and have his dressings permanently laid aside on the seventh day. He leaves hospital three weeks after operation with protective goggles, and receives his eataract glasses three weeks later, unless needling for secondary cataract be found necessary.

This, then, is a general outline of the applieation of aseptie methods as illustrated by the operation for senile cataraet. It will be observed that no chemical antiseptie came in contact with eye either before, during, or after the operation, and everything that touched the eye was aseptie. Let us now examine the methods employed more elosely, and for convenience take them in the order in whieh they occur in the description of the operation just given.

The test dressing.—A test dressing has been regularly

employed by me in the ophthalmic department of the Dundee Royal Infirmary for nearly three years, to ascertain before operating how the conjunctiva will behave under a dressing. The condition of the conjunctiva is very often deceptive, particularly in old people. It may present a normal appearance on examination, but when covered up for some hours it not unfrequently begins to discharge, like a case of chronic conjunctivitis. The presence of conjunctival discharge contra-indicates operative interference on the eyeball, because discharge is associated, as a rule, with micro-organismal activity. Now if in some cases we have no means of ascertaining the actual condition of the conjunctiva till the first dressing after operation, the importance of a preliminary or test dressing becomes evident. An unhealthy condition of the conjunctiva, for example, may not only be detected, but treated before operating, and thus save both time and trouble afterwards. With the object of ascertaining approximately the relation between this conjunctival discharge and the number of micro-organisms in the conjunctiva, I examined bacteriologically a number of eyes that had been prepared for operation. The experiments consisted in inoculating broth tubes, chiefly from the upper cul-de-sac, and keeping them at body temperature. The results obtained are briefly as follows. In the cases where we found no discharge, or simply a trace on the dressing, the broth nearly always remained clear throughout the period of experimentation, namely, fourteen days, whereas in the cases where the discharge was well marked the broth became very turbid in a couple of days or thereabout.

Preparation of drops, lotions, cotton wool, mops, and surgeon's lint.

Drops are prepared with distilled water and boiled for at least five minutes in a Strochein's drop bottle, or preferably in a glass bulb and nozzle in one piece.

Physiological salt solution (·6 per cent.) is prepared with pure sodium chloride and distilled water, and boiled for five minutes in a special douche, which prevents contamination of the solution after being sterilised. The douche is simply a Florence flask wash-bottle, with the nozzle and air-tube modified. The nozzle, when not in use, is capped with a larger piece of glass tubing sealed at one end, and the outer end of the air-tube is bent at a sharp angle so as to look downwards. Organisms are thus prevented from entering while the douche is standing, so that the solution can be kept sterile for any length of time. If the douche be used, there is a possibility of organisms entering through the air-tube with the ingoing air. This, however, can be overcome, if desired, by placing a small plug of cotton wool in the outer end of the air-tube.

Cotton wool is cut to the size and shape required for the dressing, and placed in small tin boxes provided with well-fitting lids. It is then subjected to nascent steam in a Schimmelbusch steriliser for one hour, which gives ample time for securing complete sterilisation through and through. The boxes are open during sterilisation, but are immediately closed after the process is completed. They can be carried about without the slightest fear of contamination, and are extremely convenient for private work, one box being sufficient to hold all the dressings required during the treatment of the case.

Mops and lint are made of absorbent cotton wool and surgeon's lint respectively. They are sterilised by being kept submerged in boiling water for half an hour, then wrung out with disinfected hands and placed under cover till required in a sterilised dish with overlapping lid. The lid of the mop dish is only removed while the surgeon or his assistant picks up a mop or piece of lint, and then it is lifted straight up for obvious reasons. The risk of aërial infection is thus obviated, as may be seen from the following experiments. Broth tubes were inoculated with pieces of mop and lint from the upper

layer left in the dish after the operation for cataract. Eight experiments were made at different times, with the result that the tubes remained clear throughout the fourteen days. This is very satisfactory, seeing that the experiments were made after operations performed in the wards. In order to save repetition I may mention at this stage that, accompanying the bacteriological experiments connected with this paper, a sufficient number of check or control experiments were performed, which gave negative results.

Disinfection of the surgeon's hands.—It is true that disinfection of the hands is not so important in ophthalmic operations as in operations on other parts of the body, because the ophthalmic surgeon, in a good number of his operations, does not require to touch the wound with his fingers. Still it is well to be prepared in case of accident or necessity. The method of disinfection we employ is as follows. The hands are carefully washed in warm water, with soap and soda and the free use of a clean nail-brush. They are then placed under a running tap of tepid water to remove the alkalies, and this is followed by immersion and scrubbing in a disinfecting solution, consisting of sublimate 1 in 1000 and carbolic 1 in 80, for three minutes. The hands are allowed to dry by evaporation, in order that, as the disinfecting solution adhering to the skin becomes concentrated, its germicidal properties are increased. We tested the efficacy of this method of disinfection by inoculating a test-tube containing broth with scrapings taken from underneath the ten nails, the sublimate being carefully removed beforehand. Twelve experiments were made on different days, with the result that half the tubes remained clear. Six experiments were subsequently made with the disinfecting solution increased to double strength, then all the tubes remained clear. For practical purposes the weaker solution may be relied upon for disinfecting the hands, provided one has been

careful not to touch septic cases shortly beforehand. The sister's hands were always found aseptic after disinfection with the weaker solution, probably because she is not allowed to dress or even touch septic cases. The house surgeon's hands were invariably found to be septic after using the weaker solution, he having to assist at post-mortem examinations and in the accident room.

The operating room or theatre.—Every surgeon should have an operating room or theatre for his own use exclusively, as the principle of co-operative theatres is very objectionable when viewed from the modern surgical standpoint. It is well known that surgeons differ as regards surgical methods and operative technique. One may adhere rigidly either to antiseptic or aseptic principles, another may be indifferent. An aseptician would not allow septic cases into his operating theatre, yet he must virtually surrender his principles when the theatre is shared with others who hold different views. In the new ophthalmic department of the Dundee Royal Infirmary there is an operating theatre adjoining the wards, for my own use exclusively. Formerly I operated on cataract and such cases in the wards with the patient in bed, in preference to our new general operating theatre, notwithstanding that it is one of the finest in the kingdom. In properly ventilated wards, entirely under the surgeon's own management, where no septic cases are admitted, and where the patients are kept in bed, so that there is little moving about or stirring up of dust, the risk of aërial infection of wounds is, I venture to think, less than in some of our modern operating theatres, where all sorts of cases are operated on indiscriminately.

Preparation of operating theatre.—Our operating hour being 9.30 a.m., the theatre is prepared the night before to allow sufficient time for dust to subside. Everything must be scrupulously clean. To prevent draughts, which might stir up dust, the doors and windows are kept closed during operation and for an hour before. It

may, indeed, be taken as a surgical maxim that where there is no dust there are no micro-organisms, or, if any, they are few and far between.

Preparation of instruments.—To share an operating theatre with another is bad, but to have to use the same instruments is worse. The ophthalmic surgeon should have the exclusive use of his instruments ; not only so, he should possess two separate sets, one for aseptic, the other for septic cases. This is necessary on account of the delicate edge and build of most ophthalmic instruments. In practice, to be absolutely sure, a surgeon must regard all instruments of which he knows not the immediate previous history in the same light as instruments which have been used in septic cases. Such instruments require for their sterilisation immersion in boiling water for about ten minutes' time. But this is almost certain to ruin the edge and point, *e. g.*, of a Graefe's knife, thus rendering it useless for corneal section. Instruments used exclusively for cases such as cataract extraction require only a short immersion in boiling water for their sterilisation, especially when properly treated after use. Now if the surgeon has the exclusive use of his instruments, and possesses two sets, he can choose his set according to the case to be operated on, and give instructions for sterilisation as necessary, so that he is not compelled to sterilise the instruments longer than required. Repeated sharpening of an eye instrument affects the life of the instrument, so the system of each surgeon having his own set exclusively is more economical in the long run.

Having two sets for my own use in hospital, I can rely with confidence on procuring sterilisation without affecting the edge by the following method, which has stood bacteriological tests. New instruments, and instruments that have been used in what appear to be aseptic cases, are boiled for two and a half minutes in a one per cent. soda solution, dried with a sterilised piece of cloth, and stored in aseptic boxes in a glass cabinet. Before operating

the instruments to be used are placed for two and a half minutes in boiling water, and then laid out under cover on a sterilised cloth on a tray. The method is really a modification of Tyndall's "intermittent sterilisation."

From a germicidal point of view this intermittent sterilisation is superior to continuous sterilisation for a similar period, and also less injurious to the edge of instruments than the old method of placing them for the requisite time in chemical solutions worthy of the name disinfectant. Instruments used in septic cases are sterilised for five minutes before and after use in boiling water and soda solution respectively, and kept separate from the others on the bottom shelf of the cabinet.

Sterilisation of instruments by "dry heat" or "steam" is inferior to sterilisation by boiling. It requires much longer time, is more apt to rust the instruments, and requires a special and clumsy form of apparatus, whereas sterilisation by boiling may be efficiently carried out in a saucepan, or in any flat-bottomed domestic utensil. Dry heat affects the temper of the steel if used several times at 150° C. Sterilisation of cutting instruments by absolute alcohol is not reliable, because absolute alcohol is not a true germicide as is commonly believed.

The dressings.—An ideal dressing should be *aseptic, absorbent, and antiseptic,* the term aseptic implying the absence of micro-organismal vitality, and antiseptic that which prevents the functional activity of micro-organisms. The single plaster dressing which we employ consists, as I have already said, of a small oval piece of lint or gauze, which is sterilised by boiling, and two layers of sterilised absorbent cotton wool. The lint and cotton wool are both aseptic and absorbent, and, as the moist dressing becomes very quickly dry when applied, the dressing is essentially a dry one. Now as long as dressings remain dry they are antiseptic, because there can be no micro-organismal growth or activity without moisture. Dry dressings have been proved by experiment to do more

in preventing bacterial growth than any of the so-called antiseptic dressings hitherto recommended.

The secretion from wounds forms a very fertile medium for the growth of micro-organisms, and it is therefore necessary not only to remove such secretions from the wound, but to destroy or diminish their fertility as quickly as possible. This can be secured most effectively by employing absorbent dressings, and applying them so that evaporation is not prevented but encouraged. Our dressings, being light, afford every facility for the evaporation of any moisture that may escape through the palpebral aperture, and are sufficiently thick to be impermeable to micro-organisms from without. When correctly applied they rarely become displaced for several days even in the case of restless patients.

With regard to sterilised dressings, it must be said that they possess several advantages over dressings impregnated with chemical antiseptics. For example, the wool can be cut to the exact size and shape before being placed in the steriliser, whereas the preparation and storage of antiseptic wool, &c., both in the factory and in the operating theatre, is almost certain to make them septic. Dressings may be antiseptic while not aseptic, the terms antiseptic and aseptic not being synonymous.

My object in applying the lint moist is that when the lint dries it forms a mould of the eyelids, which assists materially in preventing the dressings being displaced. Further, if necessary, the lint and mops can be sterilised along with the instruments in boiling water, and if the lint be used double or threefold and firmly wrung out, it is not essential that the cotton wool used in the dressing be sterilised. In this way one can save not only time, but also the expense and inconvenience of a steam or dry heat steriliser.

The use of a single dressing after operations on the eyeball is preferable to the old double dressing. The freedom of having one eye uncovered, even should that eye be almost blind, appears to have a psychological

effect on patients, which I believe to be of importance in the healing of wounds. Again, when both eyes are covered up, the secretion of tears, being a reflex act, is practically in abeyance. But when one eye is left open the secretion of tears goes on in both eyes, and we thus avail ourselves of a very important and natural process of irrigation. It may be said that the movements of the sound eye, by producing concomitant movements of the other eye, disturb the healing process of the wound, yet after three years of the exclusive use of the single dressing my wounds heal certainly as rapidly and soundly as before, and I have never yet seen even the slightest suggestion of the formation of a cystoid cicatrix.

The use of plaster instead of bandages which pass round the patient's head is a decided improvement, because it rarely becomes displaced, whereas bandages are apt to become displaced by the movements of the head, especially if the patient has a restless night, and the lips of the wound may in consequence be disturbed.

Ophthalmic wards.—The wards in which the patients sleep after operation should be thoroughly but carefully ventilated. Draughts should be avoided. I keep my wards quite bright, any degree of light, short of direct sunlight, being permitted. If the face and eyes be shaded with a large double shade there is no necessity for placing the whole ward in darkness. We are apt to forget that light posseses very important germicidal properties. Even diffuse daylight plays a most important part in the destruction of bacteria, and therefore from a purely sanitary point of view our wards should be kept as well lighted as the nature of the cases occupying them will permit. The large double shade, besides keeping the face and eyes in darkness, serves another very important function, namely, in preventing organisms falling on the face and eyes.

Preparation of the face and eye for operation.—It is now generally agreed that the conjunctiva, even in its normal condition, contains several species of micro-organisms,

including many of the pyogenic group. This is scarcely to be wondered at when we remember that we have in direct proximity to the eye a micro-organismal cesspool—the lacrymal sac. There are many difficulties to contend with in rendering the field of operation aseptic, not only so, but in keeping it aseptic during the healing of the wound. Can these difficulties be surmounted? With a determination to be able to answer in the affirmative, I made a series of bacteriological experiments after applying the following treatment. The eye was carefully bathed with sublimate solution 1 in 10,000 thrice daily for a period not less than three days, and the face and eyelids were treated as already described. Before making the inoculations the conjunctival cul-de-sac was carefully flushed with sublimate solution 1 in 5000, the tear ducts having been syringed with the same solution on the previous evening. The eyelids were then everted and their conjunctival surfaces brushed with a mop and lotion, followed by a second flushing of the cul-de-sacs. After the lapse of a couple of minutes or so the parts were again carefully flushed with sterilised water to remove the sublimate. A small sterilised platinum loop was then passed from end to end of the upper cul-de-sac five times without touching the margin of the eyelid, and finally brought out over the caruncle. A loopful of conjunctival secretion thus obtained was placed in a broth tube, and kept at body temperature for fourteen days. Twenty such inoculations were made from cases prepared for cataract extraction or iridectomy. The results, I regret, did not come up to my expectations, for only half of the tubes remained clear. A second series of inoculations was made at the first dressing, forty-eight hours after operation, from the cases where the broth tubes kept perfectly clear up to that time, *i. e.* from the cases which appeared aseptic. The results were contrary to my expectations, for all the tubes became very rapidly turbid.

The first series of experiments shows that one cannot always rely on making the conjunctiva aseptic, even with

sublimate solution, aided to some extent by mechanical cleansing. Sublimate 1 in 5000 is probably the strongest and most efficient antiseptic that the eye can tolerate without producing some considerable irritation. Weeks has shown that sublimate 1 in 4000 to 1 in 5000 destroys pyogenic staphylococci and streptococci in from two and a half to three minutes; yet it must not be forgotten that the time required to destroy micro-organisms in a mucous membrane, such as the conjunctiva, must be considerably greater than that required in a test-tube. The second series of experiments shows either that, while the conjunctiva can in some cases be made aseptic, it does not remain so for any appreciable length of time, or, which is more probable, that the asepticity of the conjunctiva produced by antiseptic solutions is limited to the surface, the deeper layers still containing micro-organisms which cannot be got at, but which afterwards come to the surface. This would prove that antiseptic irrigation, after all, is purely mechanical, not germicidal, in thus removing surface micro-organisms. But antiseptic solutions irritate the conjunctiva to a greater or less extent, producing hypersecretion. They are, therefore, inferior for douching purposes to physiological saline solution, which allows free irrigation without irritation. Such experiences, supported by subsequent clinical results, have made me seek to irritate the conjunctiva as little as possible, since the nearer the conjunctiva is to its normal condition the better for operative interference, believing, as I firmly do, in the truth of the old adage, let sleeping dogs lie.

With regard to the cases in the first series of experiments that proved to be septic, one important point was noted, namely, that such patients were all well over the age of sixty, while the cases that appeared aseptic were under thirty-seven years of age, with the exception of one case aged sixty-six. From this we may infer that the older the patient is the more difficulty one has in making the conjunctiva aseptic. This is an important

point in connection with operations for senile cataract, seeing that these cases are generally over sixty years of age. A further point worthy of note is that the duration of the preparatory cleansing is not so important in producing asepticity of the cul-de-sacs as might be expected, for one case, aged sixty-seven, produced dense turbidity of the broth in a couple of days, after seven days of sublimate solution, while the aseptic case, aged sixty-six, had only four days of preliminary cleansing. Now if the *Staphylococcus pyogenes aureus* and *albus*, the *Streptococcus pyogenes*, and various other forms of pyogenic bacteria be frequently found in the conjunctiva, and if we cannot rely on their removal before operating, especially in old people, how is it that we do not see more cases of corneal suppuration? Any pyogenic bacteria growing in the conjunctiva will have their virulence considerably attenuated on account of the unsuitable nutriment contained in the normal conjunctival secretions. We know that tears form the principal part of the fluid found in the conjunctival cul-de-sacs, and as they contain but 1 per cent. of solids, of which a small part only is proteid in nature, we cannot regard them as in any way a suitable nutrient medium. Further, the irrigating action of the tears must also play an important part in removing not only the organisms from the wound, but what is more important still, their chemical products.

Having thus indicated the important points in the aseptic treatment of wounds in ophthalmic surgery, my experience of its application may be summed up thus:— It is now a little over two years since I adopted asepsis in all my operations, and during that time I have done a fair share of operative work, including about 100 cataract extractions and some thirty exsections with advancement. My cataract cases were by no means selected, and many of them were operated on before maturity. One case had a well-marked facial eczema, two intractable ozæna, and a few had chronic conjunctivitis. All my operations have healed by first intention, without the slightest

suggestion of suppuration, save in one alcoholic case, where the patient became very unruly, and on successive days against orders left his bed, walked along a corridor to the water-closet, and there tore off his dressings.

In the healing of cataract cases I find, as a rule, only a trace of conjunctival injection at the first dressing, sometimes not even that, except at the seat of the wound, and in short I am convinced that the period of healing is shorter, and that there are fewer interruptions in the healing process than when I employed antiseptics.

If, then, the methods I have advocated be carefully adhered to, the surgeon may rest assured that his injured tissues have been left as nearly as possible in their physiological condition, so that any micro-organisms present will be kept at bay by the inherent antiseptic properties of the tissues themselves. Such at least clinical experience in asepsis leads me to believe.

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